Original Article

FARM MECHANIZATION LEVEL IN DIFFERENT OPERATIONS OF MAJOR CROPS IN HARYANA STATE

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ABSTRACT

A study was conducted to assess farm mechanization level of different operations for major crops in Haryana state. The districts Karnal, Fatehabad, Bhiwani and Mewat were selected for the survey. A structured questionnaire was developed for assessment of farm machinery adoption level and the scores for different categories of farm machinery have been finalized by taking expert opinion from subject matter specialists (including retired faculty) of Department of Farm Machinery and Power Engineering, College of Agricultural Engineering and Technology, CCSHAU, Hisar for assessment of adoption level of farm machinery in different operations for major crops. A total of 200 farmers of different farm sizes were interviewed. It revealed that the adoption level of farm machinery in Haryana for paddy, wheat, cotton, mustard and cluster bean was found to be 36.39, 53.35, 52.40, 61.44 and 61.53, respectively. The adoption level of mustard and cluster bean was high due to lack of advance machines and the farmers have adopted traditional implements but in case of paddy and wheat it is vice-versa.

KEYWORDS: Farm Mechanization, Adoption Level & Farm Machinery

INTRODUCTION

Mechanization refers to interjection of machinery between men and materials handled by them. In agriculture, materials are soil, water, environment, seed, fertilizer, pesticides, growth regulators, irrigation, agricultural produce and by-products. There is scope of mechanization in every unit operation of production agriculture, post-harvest and agro-processing, and rural living. The mechanization is predominantly taking place in operation where traditional practices have failed to achieve the timeliness of operation.

While in the developed world it tends to be synonymous to automation but in developing countries, like India, mechanization means any improved tool, implement, machinery or structure that assists in enhancement of workers output, multiplies the human effort, supplements or substitutes human labour that is enabling and removing, avoids drudgery or stresses that adversely affect human mental faculties leading to errors, imprecision and hazards and eventually loss of efficiency. It also means automation and controls that assure quality & hygiene. Agricultural mechanization in a limited sense relates to production agriculture (Alam, *2006*).

The scope for expansion of the area available for cultivation is limited as increasing demand for industrialization, urbanization, housing and infrastructure is forcing conversion of agricultural land to non-agricultural uses. The average size of holding for all operational classes (small and marginal, medium and large) have declined over the years and has come down to 1.16 hectare in 2010-11 from 2.82 hectare in 1970-71

(Mehta et al, 2014). The farming operations are labour intensive. Even though population of India is more, there is acute shortage of manpower for farming operations. The operational cost of human energy is more as compared to the machine energy in farming (Karale *et al, 2008*, Khambalkar *et al, 2010*).

The adoption of machine in farming operation is increasing day by day as it resulted in saving of cost of production and increasing net income of the farmers (Singh, *2006*). Some states like Punjab, Haryana excelled in farm mechanization, but had experienced it as over-investment (Singh, *2006*). The Indian scenario relating to use of farm machineries in various region differ significantly from each other. The use of machine in farming greatly depends on the soil type and the crop grown in the particular soil (Karale *et al, 2008*). There existed wide variations in development and income from agriculture between different regions of Haryana also and variations in production & income were the direct outcome of growth of necessary infrastructure and input supply arrangement (Chaudhary and Madan, *2000*). Panghal and Punia (2006) reported that farmers were facing problems in maintenance and repair of their farm machinery. Therefore, it is essential to assess the present scenario of farm machinery use in the state for further development of farm machines according to the needs of farmers.

MATERIALS AND METHODOLOGY

Location of Study

The study was conducted in villages of Haryana state. All the districts of Haryana were arranged in descending order of tractor population density (No. of tractors per 1000 ha of area). The districts were divided in four homogeneous groups. From each group one district was randomly selected. Thus, the four selected districts were Karnal, Fatehabad, Bhiwani and Mewat in order of decreasing tractor population density. From each district ten villages and five farmers from each village were randomly selected such that they represent the whole village farming households. In total, 200 farmers were selected for the study.

Assessment of Farm Machinery Adoption Level

A structured questionnaire was developed for assessment of farm machinery adoption level and the scores for different categories of farm machinery were finalized by taking expert opinion from subject matter specialists (including retired faculty) of Department of Farm Machinery and Power Engineering, College of Agricultural Engineering and Technology, CCSHAU, Hisar for assessment of adoption level of farm machinery in different operations for major crops. Personal interviews of farmers were conducted by using the above standard questionnaire and the farmers were asked about the use of each and every farm technology. The results were calculated for four categories of farmers based on operational land holdings by taking the percentage of farmers using particular machinery for a particular operation. The total score of all operations gave the level of adoption of farm machinery of that category.

RESULTS AND DISCUSSIONS

Mechanization Level of Major Crops

- **Paddy**

The adoption level of farm machinery for paddy crop amongst different size land holdings is shown in Table 1. In paddy crop, 28.28 per cent farmers used cultivator and disc harrow for tillage operation. Rotavator was used by 71.72 per cent farmers for seed bed preparation and puddling of field. Simple leveller (Gori) was used by 44.44 per cent farmers whereas 30.30 per cent farmers used laser leveller. Cage wheel was used by 28.28 per cent farmers. Transplanting of paddy

crop is done manually by labour. No farmer used self propelled transplanter. Out of 99 paddy farms, canal irrigation was available at 50.51 per cent farms whereas electric and diesel engine tubewells on 79.80 and 23.23 per cent farms, respectively. Adoption level of cono weeder and power weeder for weeding in paddy was found to be zero. Weeding was done manually. Tractor operated spray pump was used by 63.64 per cent farmers whereas 37.37 per cent farmers used manual sprayers when required. No farmers used tractor front mounted VCR reaper for harvesting of paddy crops whereas adoption level of combine harvesters was found to be 74.75. Other farmers used improved sickles for manual harvesting by family members or hired labour. Availability of implements and harvesting losses were the main constraints.

The overall adoption level of paddy thresher was found to be 16.16 per cent. All the farmers used tractor and trailer for transporting whenever required. The overall adoption level of farm machinery in paddy was found to be 36.39 per cent. In farm size upto 1 ha, 1 - 4 ha, 4 - 10 ha and more than 10 ha, the level of adoption was 23.25, 31.43, 38.08 and 40.10, respectively.

Table 1: Adoption Level of Farm Machinery for Paddy Crop (N = 99)

S. No.	Operation	Score	Land Holding Category/ Score				Overall
			Upto 1 Ha	**1 to 4 Ha**	**4 to 10 Ha**	**Above 10 Ha**	
1.	**Seed Bed preparation**						
	i. Disc harrow	4.5	4.50	2.57	1.00	0.00	1.27
	ii. Cultivator	4.0	4.00	2.29	0.89	0.00	1.13
	iii. Rotavator	10.0	0.00	4.29	7.78	10.00	7.17
	iv. Leveller (Gori)	2.0	0.00	1.00	0.89	0.83	0.89
	v. Laser leveller	4.0	0.00	0.71	1.24	1.83	1.21
	vi. Cage wheel	1.5	1.50	0.86	0.33	0.00	0.42
	vii. Paddy Disc Harrow	4.0	0.00	0.00	0.00	0.00	0.00
2.	**Sowing**						
	Transplanter	10.0	0.00	0.00	0.00	0.00	0.00
3.	**Irrigation**						
	i. Canal	2.5	0.00	1.34	1.06	1.67	1.26
	ii. Electric motor	5.5	0.00	2.95	5.26	4.81	4.39
	iii. Diesel engine	4.0	4.00	0.71	0.62	1.50	0.93
4.	**Interculture**						
	i. Cono weeder	2.0	0.00	0.00	0.00	0.00	0.00
	ii. Power weeder	3.0	0.00	0.00	0.00	0.00	0.00
5.	**Plant protection**						
	i. Manual sprayers	2.5	2.50	1.79	0.78	0.10	0.93
	ii. Tractor operated sprayer	3.5	1.75	1.00	2.41	3.35	2.23
	iii. Power sprayer	2.0	0.00	0.00	0.00	0.00	0.00
6.	**Harvesting**						
	i. Reaper	3.0	0.00	0.00	0.00	0.00	0.00
	ii. Combine harvester	10.0	0.00	2.86	9.33	10.00	7.47
7.	**Threshing**						
	Paddy Thresher	7.0	0.00	3.75	0.16	0.00	1.13
8.	**Transport**						
	Trolley	5.0	5.00	5.00	5.00	5.00	5.00
9.	**Straw management**						
	i. Stubble shaver/shredder	3.0	0.00	0.32	1.33	1.00	0.94
	ii. Hay rack	2.0	0.00	0.00	0.00	0.00	0.00
	iii. Straw baler	5.0	0.00	0.00	0.00	0.00	0.00
	Total	**100**	**23.25**	**31.43**	**38.08**	**40.10**	**36.39**

- **Wheat**

The adoption level of farm machinery for wheat crop amongst different size land holdings is shown in Tables 2. Out of 200 wheat growers, sub-soiler and plough were used by 3.5 and 8.5 per cent farmers, respectively. All the farmers used cultivator and disc harrow. Rotavator was used by 45.5 per cent. The adoption level for sowing of wheat crop was 100 per cent. Seed cum fertilizer drill is used by 77.5 per cent and zero till drill by 22.5 per cent farmers. Canal irrigation was available at 47.5 per cent farms whereas electric and diesel engine tubewells on 66.0 and 31.5 per cent farms, respectively. Tractor operated sprayer was used by 63.0 per cent farmers and manual sprayers was used by 43.5 per cent farmers whenever required. Only 10 per cent farmers used tractor front mounted VCR reaper for harvesting of wheat crop and 44.5 per cent used combine harvesters. Others used improved sickles for manual harvesting of crops by family members or hired labour. Availability of implements and harvesting losses were the main constraints. Straw reaper was used by 30 per cent farmers for straw management. All the farmers used threshers in which 57 per cent farmers used multi-crop thresher.

Table 2: Adoption Level of Farm Machinery for Wheat Crop (N = 200)

S. No.	Operation	Score	Land Holding Category/ Score				Overall
			Upto 1 Ha	1 To 4 Ha	4 to 10 Ha	Above 10 ha	
1.	**Seed bed preparation**						
	i. Sub soiler	3.5	0.00	0.00	0.16	0.28	0.12
	ii. M.B./disc/lister plough	3.5	0.00	0.32	0.16	0.66	0.30
	iii. Disc harrow	6.5	6.50	4.43	3.21	1.93	3.54
	iv. Cultivator	5.0	5.00	3.41	2.47	1.49	2.73
	v. Rotavator	6.5	0.00	2.07	3.29	4.57	2.96
2.	**Sowing**						
	Seed cum fert. Drill/ Zero till seed drill	15.0	15.00	15.00	15.00	15.00	15.00
3.	**Irrigation**						
	i. Canal	2.5	0.50	1.02	1.26	1.49	1.19
	ii. Electric motor	4.0	2.40	1.94	2.90	3.35	2.64
	iii. Diesel engine	3.5	0.70	0.80	1.13	1.70	1.10
4.	**Plant protection**						
	i. Manual sprayers	4.0	3.20	2.67	1.06	1.30	1.74
	ii. Tractor operated sprayer	5.5	1.10	1.83	4.87	3.72	3.47
	iii. Power sprayer	2.5	0.00	0.00	0.00	0.00	0.00
5.	**Harvesting**						
	i. VCR	4.0	0.00	0.18	0.51	0.65	0.40
	ii. Combine harvester	8.5	0.00	1.55	5.08	5.74	3.78
	iii. Straw reaper	8.5	0.00	1.29	2.93	4.59	2.55
6.	**Threshing**						
	Thresher	12.0	12.00	10.36	4.83	3.89	6.84
7.	**Transport**						
	Trolley	5.0	5.00	5.00	5.00	5.00	5.00
	Total	**100**	**51.40**	**51.86**	**53.85**	**55.36**	**53.35**

All the farmers used tractor and trolley for transporting whenever required. The overall adoption level of improved farm machinery available in wheat crop was found to be 53.35 per cent. In farm size upto 1 ha, 1 - 4 ha, 4 - 10 ha and more than 10 ha, the level of adoption was 51.40, 51.86, 53.85 and 55.36 respectively.

- **COTTON**

The adoption level of farm machinery for cotton amongst different size land holdings is shown in Tables 3. Out of 73 farmers, 1.37 and 16.44 per cent farmers used sub-soiler and plough for primary tillage, respectively. Cultivator and disc harrow were used by 86.30 per cent farmers for seed bed preparation whereas 21.92 per cent used rotavators.

Table 3: Adoption Level of Farm Machinery for Cotton Crop (N = 73)

S. No.	Operation	Score	Land Holding Category/ Score				Overall
			Upto 1 Ha	1 - 4 Ha	4 - 10 Ha	Above 10 Ha	
1.	**Seed bed preparation**						
	i. Sub soiler	3.5	0.00	0.00	0.10	0.00	0.05
	ii. M.B./disc/lister plough	3.5	0.00	0.46	0.41	1.17	0.58
	iii. Disc harrow	7.0	7.00	6.70	5.76	5.60	6.04
	iv. Cultivator	5.0	5.00	4.78	4.12	4.00	4.32
	v. Rotavator	6.0	0.00	0.78	1.41	2.00	1.32
2.	**Sowing**						
	Bt Cotton planter	15.0	15.00	15.00	15.00	15.00	15.00
3.	**Irrigation**						
	i. Canal	2.5	0.00	1.30	1.99	2.17	1.78
	ii. Electric motor	4.0	0.00	1.39	2.71	3.47	2.41
	iii. Diesel engine	3.5	3.50	0.61	1.54	2.33	1.44
4.	**Interculture**						
	i. High clearance Cultivator	9.0	0.00	4.70	6.09	6.00	5.55
	ii. Power weeder	11.0	0.00	0.00	0.00	0.00	0.00
5.	**Plant protection**						
	i. Manual sprayers	5.5	0.00	3.11	0.49	0.00	1.21
	ii. Tractor operated sprayer	10.5	10.50	4.57	9.57	10.50	8.20
	iii. Power sprayer	4.0	0.00	0.00	0.00	0.00	0.00
6.	**Stalk Disposal**						
	Cotton Stalk Shredder	5.0	0.00	0.00	0.00	0.00	0.00
7.	**Transport**						
	Trolley	5.0	5.00	3.48	5.00	5.00	4.52
	Total	**100**	**46.00**	**46.87**	**54.19**	**57.23**	**52.40**

All farmers used cotton planter for planting of cotton seeds. Canal irrigation was available at 71.23 per cent farms whereas electric and diesel engine tubewells were found on 60.27 and 41.10 per cent farms, respectively. High clearance cultivator was used by 61.64 per cent farmers. Others used traditional kasola for weeding whenever required. Only one farmer used power weeder. Tractor operated spray pump was used by 78.08 per cent farmers whereas others used manual sprayers of their own and relatives. Axe was used by all cotton growers for removal of cotton stalk and picking of cotton crops was done manually by labour and family members as no viable technology is available for mechanization. Trolley was used by 90.41 per cent farmers for transportation and other farmers used bullock cart or some other method.

The overall adoption level of improved farm machinery available in cotton crop was found to be 52.40 per cent. In farm size upto 1 ha, 1 - 4 ha, 4 - 10 ha and more than 10 ha, the level of adoption was 46.0, 46.87, 54.19 and 57.23, respectively. A study conducted by Konduru (2009) demonstrated that the net income of the cotton farmers would increase considerably with the mechanization of cotton harvesting but the adoption of mechanical cotton harvesting practice was possible only if efforts from many private and public agencies come together.

- **MUSTARD**

The adoption level of farm machinery for mustard amongst different size land holdings is shown in Tables 4. Out of 72 farmers, 2.78 and 6.94 per cent farmers used sub-soiler and plough for primary tillage, respectively. Cultivator and disc harrow were used by all farmers for seed bed preparation. No farmer used rotavator for seed bed preparation of mustard crop.   The adoption level of seed cum fertilizer drill in mustard is 100 per cent. Canal irrigation was available at 40.28 per cent farms whereas electric and diesel engine tubewells on 50.0 and 44.44 per cent farms, respectively.

No farmer used cultivators and power weeder in mustard. Tractor operated spray pump was used by 65.28 per cent farmers whereas other used manual sprayers of their own and relatives. Improved sickle was used by farmers for harvesting of mustard crop manually due to unavailability of suitable technology in market. Multicrop thresher was used for threshing of mustard and had 100 per cent adoption level. All the farmers used tractor and trolley for transporting mustard crop.

The overall adoption level of improved farm machinery available in mustard crop was found to be 61.44 per cent. In farm size upto 1 ha, 1 - 4 ha, 4 - 10 ha and more than 10 ha, the level of adoption was 46.0, 46.87, 54.19 and 57.23, respectively.

Table 4: Adoption Level of Farm Machinery for Mustard (N = 72)

S. No.	Operation	Score	Land Holding Category/ Score				Overall
			Upto 1 Ha	1 - 4 Ha	4 - 10 Ha	Above 10 Ha	
1.	**Seed bed preparation**						
	i. Sub soiler	3.5	0.00	0.00	0.00	0.58	0.10
	ii. M.B./disc/lister plough	3.5	0.00	0.35	0.25	0.00	0.24
	iii. Disc harrow/	7.0	7.00	7.00	7.00	7.00	7.00
	iv. Cultivator	5.0	5.00	5.00	5.00	5.00	5.00
	v. Rotavator	6.0	0.00	0.00	0.00	0.00	0.00
2.	**Sowing** Seed cum Fert. Drill	15.0	15.00	15.00	15.00	15.00	15.00
3.	**Irrigation**						
	i. Canal	2.5	0.00	0.42	1.61	1.25	1.01
	ii. Electric motor	4.0	0.00	1.73	1.86	3.33	2.00
	iii. Diesel engine	3.5	3.50	0.93	1.75	2.33	1.56
4	**Interculture**						
	i. Cultivator	6.0	0.00	0.00	0.00	0.00	0.00
	ii. Power weeder	7.0	0.00	0.00	0.00	0.00	0.00
5	**Plant protection**						
	i. Manual sprayers	3.5	3.50	2.33	2.13	2.33	2.28
	ii. Tractor operated sprayer	6.5	0.00	2.17	2.55	2.17	2.26
	iii. Power sprayer	2.0	0.00	0.00	0.00	0.00	0.00
6	**Harvesting** Improved Sickle	5.0	5.00	5.00	5.00	5.00	5.00
7	**Threshing** Multi-crop Thresher	15.0	15.00	15.00	15.00	15.00	15.00
8	**Transport** Trolley	5.0	5.00	5.00	5.00	5.00	5.00
	Total	**100**	**59.00**	**59.93**	**62.14**	**64.00**	**61.44**

- **CLUSTER BEAN**

The adoption level of farm machinery for cluster bean amongst different size land holdings is shown in Tables 5. Out of 58 farmers, no farmer used sub-soiler and plough for primary tillage. Cultivator and disc harrow were used by all farmers for seed bed preparation. No farmer used rotavator for seed bed preparation of cluster bean. The adoption level of seed cum fertilizer drill in cluster bean is 100 per cent. Canal irrigation was available at 37.93 per cent farms whereas electric and diesel engine tubewell on 65.52 and 27.59 per cent farms, respectively. No farmer used cultivators and power weeder. Tractor operated spray pump was used by 50 per cent farmers whereas other used manual sprayers of their own and relatives. Improved sickle was used by farmers for harvesting of mustard crop manually. Multicrop thresher was used for threshing of mustard and had 100 per cent adoption level. All the farmers used tractor and trolley for transporting cluster bean crop.

The overall adoption level of improved farm machinery available in mustard crop was found to be 61.53 per cent. In farm size upto 1 ha, 1 - 4 ha, 4 - 10 ha and more than 10 ha, the level of adoption was 59.33, 60.28, 61.68 and 66.07, respectively.

Table 5: Adoption Level of Farm Machinery for Cluster Bean (N = 58)

S. No.	Operation	Score	Land Holding Category/ Score				Overall
			Upto 1 Ha	1 - 4 Ha	4 - 10 Ha	Above 10 Ha	
1.	**Seed bed preparation**						
	i. Sub soiler	3.5	0.00	0.00	0.00	0.00	0.00
	ii. M.B./disc/lister plough	3.5	0.00	0.00	0.00	0.00	0.00
	iii. Disc harrow/	7.0	7.00	7.00	7.00	7.00	7.00
	iv. Cultivator	5.0	5.00	5.00	5.00	5.00	5.00
	v. Rotavator	6.0	0.00	0.00	0.00	0.00	0.00
2.	**Sowing**						
	Seed cum Fert. Drill	15.0	15.00	15.00	15.00	15.00	15.00
3.	**Irrigation**						
	i. Canal	2.5	0.00	0.65	1.00	2.14	0.95
	ii. Electric motor	4.0	2.67	2.61	2.40	3.43	2.62
	iii. Diesel engine	3.5	1.17	0.61	0.98	2.00	0.97
4.	**Interculture**						
	i. Cultivator	6.0	0.00	0.00	0.00	0.00	0.00
	ii. Power weeder	7.0	0.00	0.00	0.00	0.00	0.00
5.	**Plant protection**						
	i. Manual sprayers	3.5	3.50	2.43	1.40	0.00	1.75
	ii. Tractor operated sprayer	6.5	0.00	1.98	3.90	6.50	3.25
	iii. Power sprayer	2.0	0.00	0.00	0.00	0.00	0.00
6.	**Harvesting**						
	Improved Sickle	5.0	5.00	5.00	5.00	5.00	5.00
7.	**Threshing**						
	Multi-crop Thresher	15.0	15.00	15.00	15.00	15.00	15.00
8.	**Transport**						
	Trolley	5.0	5.00	5.00	5.00	5.00	5.00
	Total		**59.33**	**60.28**	**61.68**	**66.07**	**61.53**

Effect of Operational Land Holding on Adoption of Farm Machinery

Adoption level of farm machinery in different land holding categories was compared. It was revealed that adoption of farm mechanization increases with increase in land holding of farmers in all major crops as shown in Figure 1
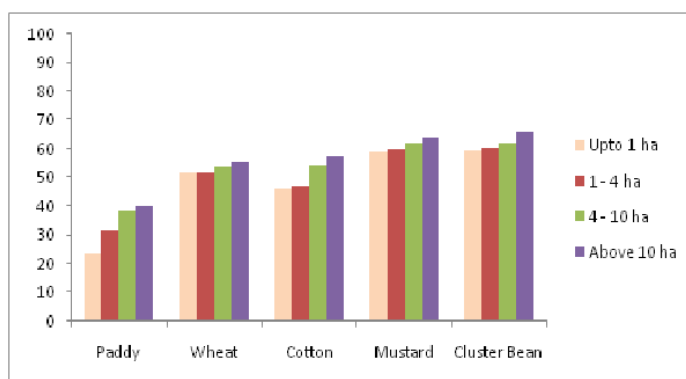
**Figure 1: Effect of Operational Land Holding on Adoption
Level of Farm Machinery in Different Crops**

CONCLUSIONS

- The adoption level of farm machinery was different for different crops as the requirement and availability of machines for different crops are different.

- In the present study, the adoption level of farm machinery for paddy, wheat, cotton, mustard and cluster bean was found to be 36.39, 53.35, 52.40, 61.44 and 61.53, respectively.

- The adoption level was lowest for paddy as advanced farm machines are available for paddy crop but farmers have not adopted because of high investment and problem in maintenance and repair while the adoption level in cluster bean is highest as advanced farm machines are not available and farmers have adopted traditional implements.

- Moreover, the adoption of different farm machinery in different land holding categories was found to increase with increase in land holding in al the crops.

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